

## **SECTION 02150**

### **UNDERPINNING**

#### **PART 1 - GENERAL**

##### **0.1 DESCRIPTION OF WORK**

- A.** Work Included: This Section specifies underpinning and support for existing structures adjacent to and above new construction, and the restoration of those structures to the conditions existing prior to the commencement of underpinning and support operations or as otherwise indicated.
- B.** Related Work: The following items are not included in this Section and will be performed under the designated Sections:
  - 1. Section 02360 - DRIVEN PILES.
  - 2. Section 03300 - CAST-IN-PLACE CONCRETE.
  - 3. Section 05100 - STRUCTURAL STEEL.
- C.** Definitions
  - 1. Underpinning: Permanent construction, as indicated, which directly transmits existing structure foundation loads to a lower bearing elevation, and which preserves the structures being underpinned.
  - 2. Support: Facilities required to prevent movement of existing structures until completion of the underpinning.
  - 3. Restoration: Reconstruction, by repair or replacement, of portions of structures removed or altered by underpinning and support operations.
  - 4. Parcel: An area as indicated, including the structures thereon and any adjacent vaults and permanent closure walls connected thereto.

##### **0.2 SUBMITTALS**

- A.** Working and Shop Drawings. Show method, staging and necessary details for the construction of underpinning and support for each structure on which work is to be accomplished. Show details of shop assemblies when required for restoration of structures.
- B.** Computations. Submit design computations to support working and shop drawings.
- C.** Procedures

1. Submit procedure for detection of movement, as specified in Part 3 "Detection of Movement" Article.
  2. Submit procedure for preloading new foundations.
- D.** Jacking Gage Calibration. Submit data for the pressure gage and jack combination certified by an accepted testing laboratory not earlier than 14 days prior to start of use for underpinning.
- E.** Support and Restoration. Submit procedures, methods, and materials lists for support and restoration.

### **0.3 QUALITY ASSURANCE**

**A.** Tolerances - Pile and Piers:

1. Offset of Top of Pile or Pier from Design Center: 1-1/2 inches maximum.
2. Out of Plumb: Two percent maximum.

**B.** Job Conditions

1. Access. Parcels will be available as indicated in Division 1. Notify the Engineer at least 30 days in advance of the date on which the Contractor requires occupancy of parcels to be underpinned, supported, and restored.
2. Working areas for underpinning and support are indicated on the Contract Drawings. If additional working areas beyond those obtained by the Authority are necessary, obtain such areas at no additional expense to the Authority.
3. Permits. The Authority will obtain and pay for permits for entry into structures and for the right to do underpinning, support, and restoration as indicated. The Contractor shall obtain and pay for other permits and make all other arrangements necessary.
4. Temporary Partitions
  - a. Where indicated, build closed temporary partitions of suitable materials to isolate the work site from the portions of the structure not occupied by the Contractor.
  - b. Upon completion of the work, remove temporary partitions and restore the area to its condition at the start of the Contract, or as otherwise indicated.
5. Maintenance of Services. Locate, protect, support and maintain uninterrupted, utilities, equipment, services, and owner's and tenant's chattels within the limits of the underpinning work, or relocate same as indicated or directed.

## **PART 2 - PRODUCTS**

### **0.1 CONCRETE AND REINFORCING STEEL**

- A.** Refer to Section 03300 - CAST-IN-PLACE CONCRETE.

### **0.2 STRUCTURAL STEEL**

- A.** Refer to Section 05100 - STRUCTURAL STEEL.

### **0.3 PILING**

- A.** Refer to Section 02360 - DRIVEN PILES, and as indicated.

## **PART 3 - EXECUTION**

### **0.1 DETECTION OF MOVEMENT**

- A.** Inscribe or firmly affix on each column, pile cap, or wall to be underpinned or supported, and at additional locations as directed by the Engineer, visual methods of determining movements. The method used is optional but shall be capable of being read to an accuracy of 0.005 foot.
- B.** Take and record readings continually during excavation, jacking, and refounding operations under the existing structure.
- C.** Stop work, notify the Engineer, and take immediate remedial action if movement of the existing structure occurs during progress of the work.
- D.** Upon completion of underpinning of an existing structure, take daily readings of the measurement points for a period of 30 days, or longer if movement persists, and report the results to the Engineer.

### **0.2 CONCRETE PIERS, WALLS AND PILE CAPS**

- A.** Install concrete piers, walls and pile caps as indicated, with the bottom at the indicated elevation and the top approximately three inches below the structure to be underpinned. Dry pack the space with 4,000 psi non-shrink grout within three days after concrete placement is completed.
- B.** Where earth form is indicated or allowed by the Engineer, install waterproof paper or board between the earth and the concrete to prevent water loss from the fresh concrete.

- C. Do not remove support of the existing structure until concrete piers, walls or pile caps have attained design strength.

### **0.3 PILES**

- A. Install pipe shells at locations as indicated and extending from the underside of existing footings to the indicated elevations, plus additional penetration if required to develop the design working load of the pile.
- B. Distribute jacking reactions over the existing structure in a manner that will not overstress or deflect more than permissible the existing structure. Allowable stresses and deflections are shown on the Contract Drawings.
- C. Weld splices where indicated. Provide watertight welds capable of developing the full strength of the pile. Align splices to ensure the straightness of the pile from top to tip. Use outside sleeves and backup rings as necessary.
- D. Where pile tip is below the groundwater table, maintain the elevation of the water inside the shell at approximately the elevation of the groundwater table during installation of the shell.
- E. After installation of the shell, apply the full design working load to the empty pile shell and maintain until there is no measurable settlement over a one hour period.
- F. Maintain the excavation within the pile a minimum of 12 inches above the tip during driving and dewater pile shells prior to filling with concrete in a manner, which will prevent loss of soil at the tip. An earth plug may be left in the pile tip or a concrete plug may be placed and cured prior to dewatering pile shells.
- G. After load testing to the design load, dewatering, and inspection of the shell by the Engineer, fill accepted pile shells with concrete in the presence of the Engineer. Keep an accurate record of the volume of concrete deposited in each pile. Deficiencies revealed by comparing the volume of the inside of the pile with the volume of placed concrete will be cause for rejection of the pile or correction of the deficiency.
- H. Load Testing. After the concrete within pile has set for at least 24 hours, test each pile by jacking to a load equal to 150 percent of the design working load of the pile. Maintain the load until there is no measurable settlement of the pile over a one-hour period. Load-test piles in those sequences and groupings, which will minimize or eliminate eccentric loadings on the existing foundation and piles. Piles will be rejected and shall be retested if, in the opinion of the Engineer, there is danger of unequal loading. Should the existing structure fail to furnish sufficient reaction to install underpinning piles to the test loads specified, provide additional reaction to prevent damage to, and movement of, the structure

during installation of piles, and to obtain specified underpinning test loads. The additional reaction shall not detrimentally affect the structure.

- I. Securely wedge in place with steel wedges those piles, which have satisfied the load-testing requirements. Weld and encase in concrete all wedges, plates, wedging struts, and piles, as indicated on the Contract Drawings.
- J. Concreting Pits. Following completion of load transfer, fill the underpinning pits with concrete as indicated. Furnish and install reinforcement, shear keys, dowels and waterstops as indicated. Place concrete to within three inches of the underside of the existing foundation. After three days, dry pack the space between foundation and concrete.

#### **0.4 BACKFILL.**

- A. Backfill in accordance with Section 02300 - EARTHWORK, after acceptance of underpinning by the Engineer.

#### **0.5 SUPPORT INSTALLATION**

- A. Install supports where necessary to support temporarily structures to be underpinned and those which will be affected by underpinning and restoration work.

#### **0.6 RESTORATION**

- A. Restore existing structures to conditions equivalent to those existing prior to the start of underpinning and support work, unless otherwise indicated. Any damage to affected buildings caused by the underpinning work shall be repaired by the Contractor at no additional cost to the Authority.

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **0.1 MEASUREMENT**

- A. Underpinning will be measured on a square foot basis for underpinning the structures in each parcel as indicated.
- B. Increased and decreased length of underpinning piles will be measured by the linear foot from the actual tip elevation to the indicated tip elevation.

#### **0.2 PAYMENT**

- A. Underpinning will be paid for at the Contract unit prices for the quantities determined as specified above.

**0.3 PAYMENT ITEMS**

ITEM NO.	DESCRIPTION	UNIT
0242.101	UNDERPINNING	SF
0242.102	UNDERPINNING PILES	LF

**END OF SECTION**

## **NOTES TO THE DESIGNER**

- A.** Any request to modify or waive the specification requirements listed below must be approved in writing by the MBTA's Director of Design:

1. None